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a semitropical world, and to my own unqualified enjoyment of his society.

BALTIMORE, MD., 31 DECEMBER, 1910.

On the study of ferns

PHILIP DOWELL

A few suggestions and occasional reflections on the study of ferns are here presented for the consideration of the reader in the hope that they may be of help to some and of interest to others.

The particular course of plant study to be pursued, like our calling in life, need not be hastily decided on. That will depend largely on circumstances and individual bent and capacity, and need not even be considered at the outset. Some of the most noted botanists have begun by simply going afield and enjoying nature. By constantly associating with plants they have become interested in them and more or less acquainted with them, and later they have become more deeply interested in some special line of plant study.

In order that the student may arrive at the safest conclusions and secure the best results in the study of ferns, he should be acquainted with the plant as it appears in its natural state. Field study should be pursued side by side with the other lines of fern study, whether we emphasize the taxonomic, morphologic, physiologic, pathologic, ecologic, economic, or other phase. When the student is acquainted with the plant as it grows in its natural surroundings, he can to more purpose study its behavior in the laboratory, or elsewhere outside of its natural state and under changed conditions. He can also with more certainty determine the natural relation-

ship of the plant as compared with closely related plants.

One illustration suggests itself for consideration at this point. Numerous unsuccessful attempts were made recently to cross *Dryopteris noveboracensis* (L.) Gray with *D. thelypteris* (L.) Gray, and as a result doubt was cast on the existence of fern hybrids in nature.* These experiments go far toward showing how great is the difficulty attending the attempt to produce hybrids among ferns artificially or experimentally. On the other hand, the fact that Dr. Hoyt did not succeed in crossing two species from which hybrid plants have been actually produced experimentally, by Miss Margaret Slosson,† rather detracts from the value of his experiments as a basis for authoritative conclusions. A little more field study might have suggested the probable futility of trying to induce two species of ferns to cross under adverse conditions when they have not been found to do so in their more healthy natural state, without first succeeding in crossing species of which the hybrids have been found actually produced in nature, and even experimentally in the laboratory.

It is not safe to confine observations and conclusions to material preserved in jars, on microscope slides, nor elsewhere, nor to plants growing under abnormal conditions away from their natural surroundings, nor to any one single phase of the problem that presents itself; but the study of such material should be carried on side by side with the study of live material growing in its natural state, and the particular phase of the problem should be viewed parallel with other problems of plant study. The best place to study our native ferns is in their natural habitat, where they are found growing wild. When it is

* W. D. Hoyt. Physiological Aspects of Fertilization and Hybridization in Ferns. Bot. Gaz. **49**: 340. 17 May 1910.

† Bull. Torrey Club **29**: 487. 3 Au 1902.

impracticable to study a plant in its natural habitat, the plant should be transplanted to a more accessible place, where it may be observed repeatedly. This place should have as nearly as possible the same conditions under which the plant grew in nature. It must not differ too much, for if the change in surroundings and conditions of growth is too great, the plant may not behave under the observer's care as it would while growing in its more natural state.

Except in the case of many of the rock ferns, our native ferns in general usually thrive well when transplanted into proper soil in the garden, not too much exposed to the midday sun. Out of about one hundred and fifty fern plants, about forty five of them hybrids, thus transplanted into a small city lot from various places in the vicinity of New York, some of the evergreen wood ferns have grown thus for six seasons. None of the transplanted ferns have died of their own accord except the silvery spleenwort, the Clayton fern, *Lygodium*, and most of the rock ferns. Some of the common ferns spread from the rootstock so rapidly that it is difficult to get rid of them after they become established, such as the sensitive fern, the lady fern, and especially the New York fern and the hay-scented fern. The chief difficulty in transplanting has been to get sufficient shade to reproduce natural conditions. As a consequence some of the more exposed plants have shown a tendency to produce wider and more full leaves toward the end of summer than at the beginning, making the divisions of the leaves appear more crowded in the later than in the earlier leaves. In the case of some of the plants the tendency has been toward a more or less permanent change in this direction. Thus plants of *Dryopteris cristata* (L.) Gray transplanted from shade have become more like those growing naturally in the open. It may be added that *Dryopteris* plants have usually not developed a robust and vigorous growth

before the third season after having been transplanted. This is probably due largely to injuries sustained in the transplanting rather than to the change in conditions.

Spores may be sown and the development and growth of the plant observed from the prothallium up, afield if practicable, otherwise under as natural conditions as possible elsewhere. In a small city lot the supply of plant food is rather small in proportion to the demand, and so it is difficult to raise young plants and preserve them from hungry vermin.

This field work, with the transplanting and raising of plants, is important in all lines of fern study, to the morphologist, physiologist, pathologist, and perhaps more especially to the horticulturist, ecologist, and systematic pteridologist. It is especially helpful in solving problems in connection with the range of variation and behavior of plants under various conditions, and problems of identity and relationship involving the determination whether a particular plant is a form, mutant, variety, species, or a hybrid. When a plant is found that cannot at once be definitely assigned to some known species, its place of growth should be carefully noted, so that the plant may be visited and its characters noted from time to time while it is still growing afield if that be practicable, otherwise the plant should be moved to a more easily accessible place. After having noted the characters of the plant at different times through a season or two, the observer can usually reach a fairly safe conclusion in regard to the identity and relationship of the plant.

For the purpose of becoming acquainted with the plant and for purposes of ready reference and permanent records, the collecting of herbarium specimens is a great help, provided care is taken to collect enough representative material and to dry it in such a way that it will preserve the natural character of the plant as nearly as possible.

Such a specimen, if accompanied by full data regarding its place of growth, when collected, etc., will serve to aid the student in recalling and fixing in mind many points of interest that might otherwise be readily forgotten. When a fern is transplanted a part of the plant may usually be made into a herbarium specimen and thus a permanent record preserved.

As for the name of the plant, that need not seriously worry the student, since the specimen may be designated by a number, at least to begin with, and the name can be supplied when wanted. The scientific names, which to the outsider and to the beginner at first seem so long and difficult, may become as easy and familiar as those of our friends. Besides, the main object is not to find the name of the plant, but to find out something about the plant itself, its conditions of growth, and its relationship to other plants. To name the plant is not systematic botany, as has been so often claimed by those who are afraid of these scientific names, and who consider it too troublesome to go afield or to bother with collecting herbarium specimens. But just why it would be more difficult to remember and refer to *Polypodium vulgare* than to *number one thousand three hundred and twenty-eight*, or to *Polypodium number seven hundred and fifty-seven*, perhaps some one can tell us who advocates the use of numbers instead of scientific names.

Let us not stand aloof and view the mountain at a distance, dreading the labor of the climb, but let us go on and up, enjoying the climb and the broader and more commanding view from the crest. We may study the plant with a view to finding out what we can about its structure, gross and microscopic, its development and growth, how it is nourished, what substances it uses for foods and what substances are harmful to it, what diseases or insect enemies it may be subjected to, how it may be transplanted and propagated to advantage, how

it varies in size, color, habit, etc., according to changing conditions, how it is related to other plants and how it may be classified, etc. Or we may pursue any one of these lines more thoroughly than the others, and this to the best advantage when we do not neglect the living plant in its natural state.

Broadly speaking, each branch of botany, or each line of plant study, is as important, progressive, and productive of knowledge and intellectual development as any other; whether we study the plant from the economic standpoint, how it may minister to our wants or otherwise affect our welfare, and how we may modify its conditions of growth, improving the good and destroying the bad; or from the purely scientific point of view, study its structure, growth and behavior under various conditions, the development and functions of its organs and tissues, its relation to environment, and the relation of the plant in these respects to other plants and its position in the systematic classification of plants; or from the point of view of education and culture, aim to develop a more intelligent, broader and better view of life.

PORT RICHMOND, N. Y.

Notes on ferns attacked by a leaf roller

PHILIP DOWELL

The fern student has no doubt noticed occasional fronds rolled up and drawn together at the tip. On closer examination he has found that a fine web has been spun, holding the parts together, and that the ball or nest thus formed is the home of a small larva. The attacks of this larva were especially noticeable during the summer of 1908, and have not been so noticeable during the past two years.

On October 10, 1908, at a meeting of the Section of